LARGE CHONDRULES AND LITHIC CLASTS IN JULESBERG (L3) AND OTHER ORDINARY CHONDRITES: PETROGRAPHIC AND MINERAL-CHEMICAL CHARACTERIZATION. Alex Ruzicka, Gregory A. Snyder, and Lawrence A. Taylor. Planetary Geosciences Institute, Dept. Geological Sciences, University of Tennessee, Knoxville, TN, 37996.

Many ordinary chondrites contain large, igneous-textured objects [1-4] of obscure origin. We have studied the petrography and compositions of a representative suite (14) of the largest "melt" objects in two thin sections and two slab surfaces of Julesberg (L3), and also the three largest melt objects in thin sections of Homestead (L5), Etter (L5), and Vishnupur (LL3-6). Our data suggest that large melt objects can be classified into two textural-chemical types: 1) Na-poor mega-chondrules and Na-poor lithic clasts, and 2) Na-rich clasts. Mega-chondrules and Na-poor lithic clasts probably formed in similar ways. From the Na-rich group, we studied four lithic clasts, one of which probably formed as a clast-laden impact melt of chondritic material.

EXPERIMENTAL TECHNIQUES-- An electron microprobe was used both for quantitative modal analyses through a digital x-ray mapping technique, as well as for quantitative (WDS) phase analyses using a focussed beam. Bulk compositions of the objects were reconstructed from modal and phase compositional data. Our approach for determining bulk compositions differs from the broad-beam EPMA technique (DBA) used often in meteorite studies, and avoids possible inaccuracy associated with the latter technique. Some aspects of the bulk chemical compositions of these objects are discussed in a companion abstract [5].

TEXTURES, SHAPES, SIZES-- Textural and size data for large melt objects are summarized in Table 1. Some large melt objects show petrographic evidence suggestive of having solidified as freely-floating melt droplets, including smooth, curving boundaries, radial variations in textures, and apparent nucleation of grains on exterior surfaces of the objects. These objects are termed mega-chondrules (equivalent to the macrochondrules of Weisberg et al. [1]). Mega-chondrules exhibit mainly barred-olivine, barred- olivine-pyroxene, or radialpyroxene textures (Table 1), in agreement with Weisberg et al. [1]. Some mega-chondrules grade texturally from barred cores to granular mantles (Table 1). Lithic clasts have a variety of textures, ranging from olivine vitrophyre, to olivine microporphyry, to more granular-textured objects composed primarily of olivine or low-Ca pyroxene (Table 1). One lithic clast (Vi-1) has a holocrystalline, poikiloblastic or poikilitic texture unlike that found in most chondrules. Another lithic clast (Jl-7) has a distinctive texture composed of mineral and lithic clasts set within an apparently igneous groundmass. The texture of this clast suggests that it is a fragment of a clast-laden impact-melt.

MODAL ANALYSES-- Modes for large melt objects vary widely, although most are rich in olivine (33-83 vol%) or low-Ca pyroxene (0-82%). These modal abundances are generally similar to that of most normal-sized chondrules [6-9]. One mega-chondrule (JI-12) and one lithic clast (JI-10) lack olivine and contain Si-rich glass (JI-12) or tridymite (JI-10). The large melt objects are poor in metal (mainly ≤0.15%, up to 1.25%) and troilite (mainly ≤0.21%, up to 1.27%).

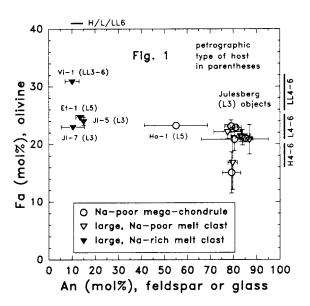
MINERAL AND GLASS COMPOSITIONS-- Mean compositions of olivine, low-Ca pyroxene, and feldspathic phases (feldspar and feldspathic glass) in large melt objects are

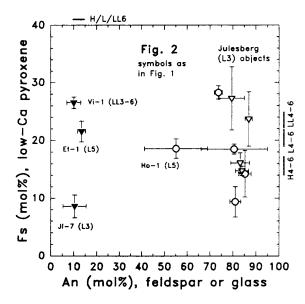
shown in Figs. 1 and 2. The objects mainly have relatively uniform compositions of olivine, similar to that found in equilibrated (Type 4-6) ordinary chondrites (Fig. 1). Within a given object, the composition of low-Ca pyroxene varies more widely than that for olivine (Fig. 2). Most mega-chondrules and most lithic clasts contain relatively calcic feldspar and

Table 1. Petrographic characteristics of large melt objects.

object	diameter [†] (mm)	texture#
mega-chondrules		
JI-2	6.0 x 8.0	barred ol-px core; granular mantle
J1-3	6.5 x 8.2	barred of
J1-9	2.0 x 4.5	barred ol core; granular mantle
J1-12	1.4 x 2.5	radial px
J1-13	1.8 x 2.4	barred ol-px
JI-15	2.7 x 2.7	barred of core
Ho-1	4.5 x 7.0	barred ol-px
Na-poor lithic clasts		
	3.5 x 4.5	ol microporphyry
J1-4	4.1 x 5.1	granular ol
Jl-6	5.0 x 8.0	barred ol-px
J1-10	2.0 x 3.3	granular px
Jl-11	2.3 x 2.7	anhedral ol-px
Ji-14	1.2 x 2.1	granular ol
Na-rich lithic clasts		
JI-5	4.8 x 5.5	ol vitrophyre
JI-7	3.0 x 4.0	clast-laden
	8 x ≥13	ol microporphyry
Vi-1	2.0 x 4.0	poikiloblastic ol-diopside-feldspar

[†] Apparent diameter in thin-section or on slab surface.
ol = olivine; px = pyroxene.





feldspathic glass (An_{70.95}), and these are classified as Na-poor (Table 1, Figs. 1-2). Some lithic clasts contain sodic feldspar and feldspathic glass (An₅₋₁₅), and these are classified as Na-rich (Table 1, Figs. 1-2). The feldspathic component in Na-poor objects is much more calcic than for feldspar present in equilibrated (Type 6) ordinary chondrites (Figs. 1-2) and in most normal-sized chondrules in weakly-metamorphosed ordinary chondrites [6-9]. In contrast, the composition of the feldspathic component in Na-rich objects is similar to that found in equilibrated ordinary chondrites (Figs. 1-2) and in most normal-sized chondrules [6-9].

Some objects show evidence for minor enrichment in Na, K, and P near their margins, suggesting that these objects experienced a minor influx of volatile elements after their formation, possibly during clast-host metamorphic equilibration.

DISCUSSION-- Mega-chondrules and large, Na-poor igneous clasts have overlapping modes and phase compositions but differ in their overall shapes and textures. These objects can be regarded as unusually large, Na-poor variants of normal-sized chondrules. Na-rich clasts form another chemicaltextural group. The tendency for these clasts to have feldspar and olivine compositions similar to that in equilibrated ordinary chondrites (Fig. 1) can be explained if these objects: (1) were metamorphosed in an ordinary chondrite parent body, or (2) formed by the melting of ordinary chondritic material. The latter explanation better accounts for the two Na-rich clasts Jl-5 and Jl-7, which contain abundant glass (31% and 13%, respectively), and which lack feldspar. The latter object is almost certainly a clast-laden impact-melt. Conceivably, all of the Narich clasts formed by impact-melting of chondritic material, as we have demonstrated elsewhere in this volume [5].

References: [1] Weisberg M.K., et al. (1988) Meteoritics 23, 309-310. [2] Keil K. et al. (1980) EPSL 51, 235-247. [3] Hutchison R. et al. (1988) EPSL 90, 105-118. [4] Ruzicka A., et al. (1995) Meteoritics 30, 57-70. [5] Ruzicka A., et al. (1997) Large chondrules and lithic clasts in Julesberg (L3) and other ordinary chondrites: bulk-chemical characterization. This volume. [6] Ikeda Y. (1983) Proc. NIPR 8th, 122-145. [7] Jones R. and Scott E.R.D. (1989) PLPSC 19th, 523-536. [8] Jones R.H. (1990) GCA 54, 1785-1892. [9] Jones R.H. (1996) GCA 60, 3115-3138.